On the Survey of the Mersey and the Dee. By Captain HENRY MANGLES DENHAM, *R. N., Resident Marine Surveyor of the Port of Liverpool.*

Captain Denham exhibited his trigonometrical survey of the Mersey and Dee, including the extensive sand-banks and channels of Liverpool bay, which, being delineated on the scale of four inches to the mile, afforded a detailed development of the submarine undulation, illustrative of his remarks on the action of the tidal stream in connexion with those differently shaped estuaries. The self-choking effects of the Dee, with its expansive mouth and gradual contraction, resembling a lateral section of a cone, were contrasted with the scouring effects of the Mersey, its contracted mouth and attenuated throat resembling a lateral section of a bottle with its neck pointed seaward. To this figure of the estuary of the Mersey, Capt. Denham ascribed the impetus of its expansive back-water, which has recently forced a channel of half a mile wide, and two miles long, and twelve and thirty feet below the low-water level, through sands, situated eight miles outside its coast-line confines, *at a tangent to its regular course.* Thus a most valuable and unexpected channel has been produced for navigation, and a compensating escape provided for its waters at a time when an injurious deposit was taking place across its usual path, where the efforts of the ebb become evanescent. The position was ascertained by Captain Denham to be fourteen miles below the docks, or tidal straits, where the first impulse amounts, (and continues so five hours out of six) to five miles per hour on spring-tides. The form of this channel corresponds to the contour of incidence and reflection throughout its whole course, and indicates the exhaustion of the velocity of the water by expansion in the proportion of 14 to 25. It proves also the certain power of the Mersey to command a *navigable* avenue to the ocean, so long as its guardians preserve the high-water boundaries from artificial contraction.

In the course of his professional duties, Capt. Denham proposes to himself a further investigation of the proportions of silt, &c. held in suspension and gradually deposited, as well as a determination of certain peculiarities in the *vertical* range of the tides with reference to atmospheric elasticity. He has already, by the liberal arrangements of the dock-trustees, been enabled to connect a series of observations, even to *five-minute grades*, during the twenty-four hours. From these, by extensive tabulary interpolations, the half-hourly rise and fall upon every stage of the moon was determined, and the mariner enabled at a glance to know what water existed in excess of his chart, and hence *when* certain subsidiary channels were passable, or the several banks might be crossed. He had thus ascertained the tidal *establishment*, or the time of high-water upon full and change of the moon, and determined another constant proportion as a standard—for graduating future tide-gauge operations, for testing soundings hereafter, for fixing a point of departure for engineers when levelling eminences, canals, railroads, &c.,—viz. the oscillating point, or mean centre which every six hours is common to neaps and springs, and quoted by seamen generally as the *half-tide mark.* Capt. Denham is not as yet prepared to state whether some *small* constant difference might not be found as to the *instant* of the half-elapsed time of spring-tide, high and low water, and that of neaps, producing the actual *half-range* of tide to *inches*; but so satisfied is he of a closer approximation than is generally allowed, that, though he would never propose *to adjust soundings to that half-tide level,* because the mariner would have to make variable allowances to ascertain the least water he was to expect in the channel before him, yet he would suggest for scientific and frequent practical references the desirability of engraving on some rocky spot of every harbour, and sheltered portions of coast, the well-defined *half-tide level,* DATED; for, on the assumption that such a level is (no matter what the whole amount of rise and fall differs), in the same latitude, equidistant from the earth's centre, then we have a standard of obvious importance to science. By reference to this constant level those discrepancies may be adjusted which attend engineering operations, designed to cooperate on opposite sides of an isthmus, where the vertical range differs, and either *high* or *low* water level *separately* be started from, instead of the mean centre of *each range,* i.e. *half-tide* level.

The Rev. WM. WHEWELL made the following remarks for the purpose of exemplifying the application of physical science to geological researches.

1. The permanence of the level of mean water, which Capt. Denham has recently proved by trial at Liverpool, suggests the proper mode of making such observations on the permanence of the relative level of land and sea, as were formerly recommended by the Association. In tidal seas the level of the ocean must, for such a purpose, be estimated with reference, not to the height of high or of low water, which is variable on many accounts, but to the height of *mean water.* This mean water is to be obtained by taking at least two high waters and the intervening low water, or two low waters and the intervening high water. A very few tides will give a near approximation to the true mean level; but the more there are taken, the more accuracy will be obtained. This mean level must, of course, for the purposes now spoken of, be referred to some durable mark in the solid ground. 2. The phænomena of terrestrial magnetism, being apparently connected with the internal constitution of the earth, are of interest to the geologist. According to the most recent researches of Hansteen the earth has four magnetic poles, all of them revolving in the neighbourhood of the geographical poles; and the periods of these revolutions are respectively about 4600, 1740, 1300, and 860 years. These times, though long as historical periods, are short compared with many of those cycles of which geological researches and astronomical calculations prove the existence; and it is impossible not to feel a great curiosity respecting the nature of the subterraneous changes which take place in such periods. It concerns the geologist therefore, no less

than the physical philosopher, to further the progress of our knowledge of terrestrial magnetism. 3. The heat of the interior parts of the earth has always been treated of by those who have established the theory of heat upon mathematical principles. They have hitherto considered it as proved, upon such principles, that the increase of temperature of the substance of the earth as we descend, proves the reality of an *original heat.* But M. Poisson, in his *Theorie de la Chaleur* just published, dissents from this opinion, and is disposed to assign another reason for the higher temperature below the surface. He observes that the cosmical regions in which the solar system moves have a proper temperature of their own; that this temperature may be different in different parts of the universe; and that if this be so, the earth would be some time in acquiring the temperature of the part of space in which it has arrived. This temperature will be propagated gradually from the surface to the interior parts. And hence, if the solar system moves out of a hotter into a colder region of space, the part of the earth below the surface will exhibit traces of that higher temperature which it had before acquired. And this would by no means imply that the increase of temperature goes on all the way to the centre. Though these opinions may not gain the assent of geologists, it may be proper that they should be aware that such have been promulgated.

On the Geographical Position of Cape Farewell. By Dr. West.

The chief object of the memoir was to show, That Cape Farewell, so named by Davies in 1585, is not, as stated by Egede, Crantz, and Giesecke, on the island of Sermesok, but on another island many miles to the south-east of it;—That Staten Hoek is not, as generally laid down in charts, a promontory on the southernmost extremity of the main land, nor yet, as stated in the Edinburgh Review (No. 59,) an *inlet*, but that it is identical with Cape Farewell, and received its name, which signifies the *States' Promontory*, from the Dutch navigators. Dr. West also showed that this fact, though now apparently quite unknown in these countries, was understood and plainly stated nearly ninety years ago in an English work, Drage's Account of the Voyage in the California in 1746 and 1747.

The memoir was accompanied by a copy of Graah's Chart of Greenland, the latest and most correct extant, from which it appeared that Giesecke, in his account of Greenland in Brewster's Edinburgh Cyclopædia, and in his map of that country in the 14th vol. of the Transactions of the Royal Irish Academy, has placed the island of Sermesok nearly a degree too much to the south; that no part of the main land could possibly be seen from the open sea to the south of the coast of Greenland; and that the island most to the south of the strait Ikareseksoak is the only one on which is a cape answering to the description given by navigators of Cape Farewell.

Dr. West concluded his memoir by expressing his opinion that Captain Graah, by his having satisfactorily ascertained that there